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FINAL REPORT

# HANCOCK MINE PROJECT
MT A/E 86-46-128
SHERIDAN COUNTY, MONTANA

December, 1987

Prepared for:

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Abandoned Mine Reclamation Bureau
Department of State Lands
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Project Inspector

*L. C. HANSON COMPANY*
CONSULTING ENGINEERS & SURVEYORS
HELENA — GREAT FALLS — GLENDIVE

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# FINAL REPORT

# HANCOCK MINE RECLAMATION PROJECT

## I. INTRODUCTION:

### A. Project Objectives:

The Hancock Mine Project was undertaken at the site of six partially collapsed abandoned coal mines for the purpose of identifying potential hazards to public safety, within the right-of-way of a public road and the adjacent cultivated and range land areas; alleviating the immediate hazards of any mine related surface elements found; and controlling further mine void collapse within the right of way to limit the surface effects to minor settlement.

### B. Project Location:

Hancock Mine Project is located 8 miles north of Medicine Lake, Montana, and 0.5 mile east of Montana State Highway No. 16. The location is further described as the SW 1/4 and the W 1/2 SE 1/4 of Section 30, and the NE 1/4 NW 1/4 amd the NW 1/4 NE 1/4 of Section 31, all in T33N, R56E, PMM, Sheridan County, Montana.

### C. Site Description:

The Hancock Mine Project consists of six mining operations at three locations. Four horizontal adits were located in the SW 1/4 of Section 30; these were designated on the Plan Sheet as Areas #1 and #2. One horizontal adit in the SE 1/4 of Section 30 was part of an operation which included a vertical adit shaft in NE 1/4 of Section 31; this operation was designated as Area #5. The sixth operation consisted of an unknown number of vertical adit shafts in the NW 1/4 of Section 31; these were designated as Areas #3, #4 and #6.

Areas #1, #2 and #5 are located in rangeland. Surface elements of mine related activity consisted of numerous subsidence holes and fissures, several partially collapsed shafts, and five open adit trenches. A sizable coal spoil pile marked the adit shaft in Area #5. The adit trenches are in the north face of a bench slope. The elevation difference between the trench bottom and the bench top is approximately 100 ft. The pitch of the slope is approximately 2:1.

Areas #3, #4 and #6 are located atop the bench. Area #3 is adjacent to and north of a county road; Area #4 includes 1/4 mile of county road right of way; and Area #6 is adjacent to and south of the road. The majority of the area in NW 1/4 of Section 31 is cultivated. Of these three, Area #3 contained the majority of the surface elements of mine related activity which consisted of numerous subsidence holes. Area #4 had one subsidence hole which appeared in the winter of 1986. Area #6 contained the remains of one tipple foundation and a grass plot reported to be the location of an air shaft previouly backfilled.

## II. DESCRIPTION OF RECLAMATION PROJECT

### A. Project Scope:

The goal of the project was to reclaim the surface of lands disturbed by past mining activity and to locate and backfill those portions of underground workings which were within the right of way of the county road. Surface work included cleanup of debris and coal waste, closing mine openings, backfilling and regrading subsidence features, and restoring ground cover on disturbed areas. Subsurface work included exploratory and production drilling, stowing gravel and pumping grout.

### B. Project Planning:

ADMINISTRATION AND FUNDING:
Funding for the reclamation, planning and administration of the Hancock Mine Project was provided through a grant from the United States Department of Interior, Office of Surface Mining. The Montana Department of State Lands, Abandoned Mine Reclamation Bureau administered the grant. L.C. Hanson Co. prepared the reclamation plan and also administered the construction contract, performed on-site inspection of construction and acted as the Department of State Lands on-site representative.

PRELIMINARIES:
L.C. Hanson Co. based the planning for this project on interviews with persons whom had either worked in the mine or had personal knowledge of the mines and findings from exploratory boreholes drilled during the summer of 1986.

The exploratory drilling indicated that probably one quarter mile of the county road was underlain with mine voids. 16 boreholes, of the initial 40 holes drilled in Area #4, encountered either an intact mine void or collapsed

substrata. Underground camera surveys of the mine voids in the eastern portion of the quarter mile showed many of the workings to be intact.

The mine in Area #5, was the only working for which a mine map was found. In Area #6, farming work had thoroughly obliterated the evidence of any mine locations.

SCHEDULE OF EVENTS:
The following delineation of events tracks the preliminary phase of the project from assignment to bidding.

| | |
|---|---|
| May 5, 1986 | L.C. Hanson Co. commenced data gathering for the Hancock Mine Project. This included mapping, landowner contact, record search, and site evaluation. |
| July 21, 1986 | Exploratory drilling commences and is completed in early October, 1986. |
| October 28, 1986 | Preliminary plan and budget are completed. |
| December 31, 1986 | Final plan is approved. |
| January 5, 1987 | Landowners approve the reclamation plan. |

## C. Construction Phase:

SCHEDULE OF EVENTS:
The following delineation of events tracks the construction phase of the project from bidding to final completion.

| | |
|---|---|
| April 2, 1987 | L.C.Hanson Co. conducts the Pre-bid Conference at the site. Attendees include a representative of each of the following: the Montana Department of State Lands, Abandoned Mine Reclamation Bureau; L.C.Hanson Co.; Nemont Telephone Cooperative; and sixteen construction Contractors. |
| April 16, 1987 | The Department of State lands opens the four bids received. |
| April 20, 1987 | Notice of Award is issued to Shumaker Trucking and Excavation Contractors, Inc. |

| | |
|---|---|
| May 11, 1987 | Notice to Proceed is issued to the Contractor. |
| May 13, 1987 | L.C. Hanson Co. conducts the Preconstruction Conference at the site. Attendees include a representative of each of the following: Montana Department of State Lands; L.C. Hanson Co.; and Shumaker Excavation. |
| May 14, 1987 | Exploratory and production drilling commences. |
| May 15, 1987 | Surface work commences. |
| May 27, 1987 | Pneumatic stowing commences. The surface work is substantially complete. |
| June 4, 1987 | The estimated production drilling footage is exceeded. |
| June 10, 1987 | On-Site Representative requests Contractor to submit estimate of cost for Structural Shaft Closure and temporary power line relocation. |
| June 15, 1987 | Contractor submits quote for shaft closure. |
| June 16, 1987 | Contractor requests change in casing piped diameter. |
| June 17, 1987 | On-Site Representative informs Department of State Lands of subsurface findings and anticipated overrun necessary to complete work. |
| June 23, 1987 | Pressure grouting commences. |
| June 26, 1987 | Contractor requests change from pneumatic stowing to hydraulic stowing. |
| June 29, 1987 | Pay Request No. 1 is issued. |
| June 30, 1987 | Contractor issues quote for powerline relocation. |
| July 1, 1987 | DSL representative visits site to review work and hydraulic stowing request. Hydraulic stowing is rejected. |

| | |
|---|---|
| July 7, 1987 | Pay Request No. 1 is accepted. |
| July 10, 1987 | Work Directive Change #1 is issued. This Directive includes increases in all subsurface work and negotiated cost of the shaft closures and powerline relocation. |
| July 27, 1987 | Pay Request #2 is issued. |
| July 30, 1987 | Work Directive Change #2 is issued. This Directive includes additional increases in all subsurface work. |
| August 17, 1987 | Pay Request #2 is accepted. |
| August 19, 1987 | Project is substantially complete. Only revegetation work items remain. DSL directs L.C. Hanson Co. to perform exploratory drilling adjacent to the residence at west end of subsurface work. |
| August 28, 1987 | Summer erosion control materials are installed. |
| August 31, 1987 | Pay Request #3 is issued. |
| September 8, 1987 | Contractor rejects Pay Request #3, issuing claim for additional monies for Traffic Control, Shaft Closure and power line relocation. |
| September 9, 1987 | Exploratory drilling adjacent to residence is completed. |
| September 14, 1987 | L. C. Hanson Co. reviews Contractor's claim and issues letter to Contractor. |
| September 16, 1987 | Exploratory drilling report is issued. |
| September 23, 1987 | Pay Request #3 is accepted. No resolution of claims made. |
| October 6, 1987 | Revegetation work is completed. |
| October 9, 1987 | Pay Request #4 and Change Order #1 are issued. No resolution of claims made. |

| | |
|---|---|
| November 6, 1987 | D.S.L. resolves additional claims. Pay Request #4 and Change Order #1 are revised and reissued. |
| November 19, 1987 | Pay Request #4 (Final) and Change Order #1 are accepted by all parties. |

## D. Equipment:

| | |
|---|---|
| Drilling Rig: | Gardener Denver, air rotary |
| Front End Loaders: | Waldon 50, 1/4 cyd. bucket<br>Cat 966, 4 cyd. bucket |
| Backhoe/Front Loader: | Case 580, 12 ft. reach, 3/4 cyd. bucket |
| Air Compressor: | Ingersol Rand 900, 900 cfm<br>Gardener Denver 600, 600 cfm |
| Winch Trucks: | Baldwin Lima Hamilton winch tractor, extending boom, range 20 ft. to 60 ft. |
| Grout Pump: | Case Cretepump, twin hydraulic piston |
| Water truck: | 2 Truck mounted tanks, 4,000 gal. and 1800 gal. |
| Dozer: | Cat D8, blade and ripper |

## E. Work Description:

The success of the construction phase depended on the cooperation of a number of parties including: prime Contractor; drill subcontractor; and material suppliers; and the on-site Engineer.

It was the responsibility of the prime Contractor to deliver, maintain, and operate the equipment capable of producing and placing grout and stowing gravel in the mine void, and equipment capable of performing the surface work; provide the required exploratory and production drilling; and supply all material necessary to complete the work.

The on-site Engineer was responsible for inspecting completed work items; directing the location and depth of exploratory and production drilling; conducting underground exploratory surveys; monitoring the placement of the backfill material; tracking pay quantities; and communications between the Contract parties.

The work items for the Hancock Project were delineated in the Contract under two categories: Surface Reclamation and Subsurface Reclamation. The Contractor was given the option of performing the work in the categories concurrently.

## SURFACE RECLAMATION:

The Contractor commenced surface work in Area #3 and #4 and proceeded to Area #1, #2 and #5. The Contract (Special Provision--4.24 ORDER OF WORK) prescribed this sequence for three reasons: (1) Area #3 was designated as the equipment parking and stockpile area for the subsurface work. Preparing this area first would allow the subsurface work to proceed immediately. (2) Area #4 comprised the total area of subsurface work. Within that area, 30 ft. south of the county road, a new subsidence hole had opened during the winter of 1986. It was deemed necessary to investigate this recent subsidence activity immediately to gather more data about the subsurface conditions. (3) An objective of Department of State Lands and L.C. Hanson Co. design is to limit surface disturbance to a minimum. This prescribed sequence directed the Contractor to pass between work areas only twice; thus, limiting disturbance to access routes.

Work along the northern portions of Areas #1, #2 and #5, involved mostly salvaging topsoil,regrading the area of subsidence features and open adit trenches, replacing topsoil, and restoring vegetation. All of the topsoil and regrading work in these portions was performed with a tracked dozer due both to the small areas involved--less than one acre each--- and the steep slopes encountered--nominally 2:1. The only major problems encountered in these portions involved disposal of the large quantity of boulders retrieved with the topsoil and difficulty in restoring ground cover to those finished slopes which were 3:1 and steeper. Many boulders were removed during topsoil salvage and disposed in subsidence holes; others were gathered after the topsoil was spread and were buried. Work to restore vegetation on steep slopes often required hand labor since equipment could not safely operate at angles perpendicular to the slope.

Work along the southern portions of Areas #1, #2 and #5, involved mostly salvaging topsoil, regrading the area of subsidence features, exposing amd backfilling fissures, disposing of coal waste materials, closing open shafts, replacing topsoil, and revegetating all disturbed areas. The shafts in these portions were partially collapsed and one was reported to have been backfilled previously. Originally, these were scheduled for backfill using only earthen material, but during the spring of 1987, a decision was made to close such openings in a manner less prone to settlement. During the construction phase, concrete slabs were prescribed for these openings. No major problems were encountered in these areas.

Surface work Areas #3, #4 and #6, involved mostly salvaging topsoil,regrading the area of subsidence features, flooding and backfilling an active subsidence hole, disposing mine related debris, replacing topsoil, and revegetating all disturbed areas. No major problems were encountered in these areas.

The flooding of the active subsidence hole in Area #4 was performed in an attempt to induce further collapse. While the water did successfully settle the loose material, it did not successfully open the hole to the adjacent workings.

The only major problem encountered in surface work was difficulty in attempting to place seed and fertilizer through the mulch. The mulch had been applied earlier to control erosion and the desired result was to complete the ground cover restoration without significantly reducing the effectiveness of the erosion control. Both a hoe drill and disk drill were used on the project. Neither drill performed as well as desired; however the end product was acceptable. The actual success of these methods will not be determined until such time as the seed germinates and establishes itself or erosion occurs.

## SUBSURFACE RECLAMATION:

The drilling subcontractor commenced subsurface work with the drilling of exploratory boreholes. Under the direction of the Field Engineer, this work started in Area #4 adjacent to Area #3 (see Appendix C--Mine Layout sheets 1 & 2 of 4). During preliminary work, 12 boreholes were drilled in this area and during construction 90 boreholes were placed in an area 480 ft. by 90 ft. and included both the road surface and ditches. 74% of these boreholes encountered mine void and 65% were utilized as production holes. Because much of the void encountered here consisted of intact mine rooms it was possible for the Field Engineer to extensively use underground camera equipment to survey and map the workings. The preliminary exploratory work performed here in 1986, indicated that the road might be underlain with about 560 Lft. of mine void. Contruction exploratory work found the area underlain with nearly 830 Lft. of mine void. In addition to the intact rooms, the drilling also located about 150 Lft. of partially collapsed workings at the east end of the area. Some of the mine void had migrated to nearly 50 ft. above the original workings.

Adjoining the above described area to the west was an additional 528 Lft of roadway also undermined (see Appendix C--Mine Layout sheets 2, 3 & 4 of 4). Preliminary exploratory drilling and subsequent construction drilling found no

intact workings in this area. The drilling did indicate that the workings found in this area were not a continuation of those to the east. This finding is based on the variance of substrata material and coal seams in the two areas (see Appendix C--Soils Profiles). 77 boreholes were drilled in an area 50 ft. by 528 ft. 43% of these holes encountered collapsed workings and 30% were used as production holes. Nearly all of the production holes were located on the road surface.

The total construction drilling footage consisted of 11428.5 Lft. of 4-3/4 in. borehole and 5833.0 Lft of 8 in. borehole. This work was completed using 38 working days over a period of 82 calendar days. The majorproblem encountered in the drilling was the tendency of large rocks to detach from the borehole wall during the reaming of boreholes; thus, trapping the drill stem and bit in the borehole. These incidents resulted in the loss of production time and the loss of stem and bit in one hole. Normally, drilling at abandoned mines uses air to retrieve drill cuttings; however, at this mine the use of water and a foaming additive was frequently used for retrieval to assist in maintaining the integrity of the borehole wall during drilling and production.

The Contractor commenced subsurface work with underground stowing backfill work. This was initiated with the construction and development of pneumatic stowing equipment. The development of the equipment continued sporadically throughout the remainder of the stowing work. The stowing equipment operated for 39 working days, usually 8 hours per day, and placed a total of 1,967 tons of gravel. Production capacity ranged from a low of 2 tons per hour to a high of 20 tons per hour. Average production for the entire period was about 6 tons per hour. 78 calendar days were used to complete this work item.

The Contractor's equipment utilized a stowing method that combines gravity-fed stowing material and a high volume air stream at the mine void level. For much of the stowing period, the air supply equipment consisted of a 900 cfm. compressor. During the latter portion of the period a 600 cfm. compressor was used in tandem. Production rates for twin compressors reached 20 tons per hour. Nominal surface gauge pressure for both compressors was about 85 to 90 psi.

One of the major problems encountered in this work was the inexperience of the Contractor, supervisor and crew with a successful high pressure pneumatic stowing system. In addition, the Contractor had no experience with an operable system of the design he choose to use and was unwilling to fully utilize the counsel of the Field Engineer whom had

experience with similar equipment, stowing material and field conditions. These factors resulted in low production rates over much of the work period.

One major cause of low production rates, was the the Contractor's persistent attempts to stow backfill material which had a very high moisture content. This not only resulted in slowed production and poor underground displacement, but also frequently resulted in plugging the borehole and the abandonment of the hole at several locations.

While pneumatic stowing is applicable to intact mine rooms, pressure grouting was used in those areas where collapsed workings were encountered. Pressure grouting was performed using a hydraulically-driven piston grout pump and 3 in. steel discharge pipe. The pump was capable of delivering a steady surface gauge pressure of 100 psi. and thrust pressures of 150 psi. Using this equipment the Contractor successfully placed 730 cyd. using 15 working days. This work was completed in 71 calendar days.

One problem encountered with this work was the cycle time of the grout delivery. The grout was batched at a local plant nearly 15 miles from the site and delivered in mixer trucks. Cycle time for an 8 cyd delivery was frequently 110 minutes. A problem resulted when less than 3 trucks were assigned to the project because an insufficient quantity of grout was available to permit continuous pumping. Continuous pumping was necessary at any one borehole for the following reasons:
(1) The eighty foot vertical column of grout in the discharge line would segregate if allowed to stand for more than a period of 5 to 10 minutes. This resulted in "sand plugs" which had such high wall friction with the discharge pipe that the pump could not move them. These plugs were created when the water escaping at the bottom carried the fine cement and flyash particles away from the larger sand particles.
(2) The backfill zone consisted of dry unconsolidated material which probably absorbed a sufficient amount of the mix water to leave a very stiff mix which the pump could not move.

## III. COST AND QUANTITY SUMMARY:

### A. Final Pay Request and Reconciliation Change Order

A copy of the Final Payment Request and Reconciliation Change Order for the Hancock Mine Project are contained in Appendix A. These documents summarize the final quantities and costs for each work item.

## B. Change Orders

The following Change Orders were executed during the course of the project: Change Order No. 1--Reconciliation of Final Quantities, Close Mine Opening (Structural Closure), Change Casing Diameter, and Temporarily Relocate Overhead Power Line.

## C. Unit Cost Per Area:

The following table delineates the work items, quantities, and costs involved in the HANCOCK MINE RECLAMATION PROJECT:

**SURFACE WORK:**

| **WORK ITEM:** | **QUANTITY** | **COST/ UNIT:** | **TOTAL COST:** | **COST/ACRE (SURFACE) (4 ACRES)** |
|---|---|---|---|---|
| MOBILIZATION: | 1 | LUMP SUM | 5,000.00 | 1,250.00 |
| DEBRIS CLEANUP: | 1 | LUMP SUM | 200.00 | 50.00 |
| REMOVAL OF STRUCTURES: | 1 | LUMP SUM | 400.00 | 100.00 |
| SALVAGE AND REPLACE TOPSOIL: CYD | 2122.9 | 2.00 | 4,245.80 | 1,061.45 |
| BANK CAVING: HR | 1 | 50.00 | 50.00 | 12.50 |
| SUBSIDENCE BACKFILL: CYD | 220.0 | 4.00 | 880.00 | 220.00 |
| SUBSIDENCE GRADING: | 1 | LUMP SUM | 2,200.00 | 550.00 |
| FISSURE TRENCH EXCAVATION: LFT | 455.0 | 3.60 | 1,638.00 | 819.00 |
| WASTE PILE DISPOSAL: | 1 | LUMP SUM | 200.00 | 50.00 |
| PROVIDE WATER: MGAL | 18.0 | 25.00 | 450.00 | 112.50 |
| FARM FENCE: LFT (INCLUDES SINGLE PANEL) | 104.5 | 2.24 | 234.50 | 58.63 |
| REVEGETATION: AC (INCLUDES FERTILIZER, SEED & MULCH) | 4 | 1,243.03 | 4,972.10 | 1,243.03 |

SURFACE WORK:

| WORK ITEM: | QUANTITY | COST/ UNIT: | TOTAL COST: | COST/ACRE (SURFACE) (4 ACRES) |
|---|---|---|---|---|
| STRUCTURAL SHAFT CLOSURE: (CHANGE ORDER #1) | | | | |
| | 1 | LUMP SUM | 3,498.44 | 874.61 |
| CLOSE ADIT: EQUIPMENT USE (CHANGE ORDER #1) | | | | |
| HR | 1.0 | 125.00 | 125.00 | 31.25 |

TOTAL: $24,093.84
PER SURFACE ACRE: $ 6,023.46

SUBSURFACE WORK:

| WORK ITEM: | QUANTITY | COST/ UNIT: | TOTAL COST: | COST/ ACRE (SURFACE)* | COST/ACRE (MINE FLOOR)** |
|---|---|---|---|---|---|
| TRAFFIC CONTROL: | | | | | |
| HR | 264.0 | 46.00 | 12,144.00 | 8,317.81 | 30,548.72 |
| BOREHOLE DRILLING: | | | | | |
| FT | 11,428.5 | 2.75 | 31,428.37 | 21,526.28 | 80,585.57 |
| BOREHOLE REAMING: | | | | | |
| LFT | 5,833.0 | 3.00 | 17,499.00 | 11,985.62 | 44,869.23 |
| CASING PIPE: | | | | | |
| LFT | 326.25 | 5.54 | 1,807.43 | 1,237.97 | 4,634.44 |
| WATER INJECTION AND FLOODING: | | | | | |
| MGAL | 45.4 | 25.00 | 1,135.00 | 777.40 | 2,910.26 |
| UNDERGROUND MINE STOWING: (INCLUDES STOCKPILING) | | | | | |
| TON | 1,967.4 | 14.90 | 29,314.26 | 20,080.45 | 154,302.27*** |
| PRESSURE GROUT INJECTION:(INCLUDES SETUP) | | | | | |
| CYD | 729.25 | 93.50 | 68,186.25 | 46,702.91 | 304,931.25**** |
| GRAVITY GROUT INJECTION: (INCLUDES SETUP) | | | | | |
| CYD | 123.8 | 65.00 | 8,047.00 | 5,511.64 | 20,633.33 |
| FILL EXISTING BOREHOLE NO VOID: | | | | | |
| EACH | 138.0 | 65.00 | 8,970.00 | 6,143.83 | 23,000.00 |
| FILL EXISTING BOREHOLE INTO VOID: | | | | | |
| EACH | 1.0 | 175.00 | 175.00 | 119.86 | 448.72 |

SUBSURFACE WORK:

| WORK ITEM: | QUANTITY | COST/ UNIT: | TOTAL COST: | COST/ ACRE (SURFACE)* | COST/ACRE (MINE FLOOR)** |
|---|---|---|---|---|---|
| ROAD RESTORATION: | | | | | |
| LFT | 1008.0 | 3.50 | 3,528.00 | 2,416.44 | 9,046.15 |
| TEMPORARILY RELOCATE POWERLINE: (CHANGE ORDER #1) | | | | | |
| | 1.0 | LUMP SUM | 681.90 | 467.05 | 1,748.46 |

TOTAL: $182,916.84
PER SURFACE ACRE: $125,285.07*
PER MINE FLOOR ACRE: $469,015.92**

NOTES:

* Surface acreage includes area within the ROW of the county road for a distance of 1008 Lft; approximately 1.46 acre.

** Mine floor acreage consists of 1090 Lft. of floor and assumes an average room width of 16 ft; approximately .39 acre.

*** Mine floor acreage consists of 8640 sft. of floor serviced and assumes an average room width of 16 ft; approximately .19 acre.

**** Mine floor acreage consists of 8800 sft. of floor serviced and assumes an average room width of 16 ft; approximately .20 acre.

## IV. SUMMARY

### A. Accomplishments:

This project successfully achieved its objectives of eliminating discernible mine related surface features which were included within the project and stabilizing those underground workings which were located and were beneath the county road surface.

### B. Engineers Comments:

While the project was successful in the technical sense that the project objectives were achieved, it did so with an overall increase in cost and time of about 42% higher than the original Engineer's Estimate. The overrun in construction cost is attributed to the substantial increase in subsurface work over the original estimate. Factors which account for the underestimate include: (1) the combining of

exploratory drilling with the backfilling project; (2) the lack of information concerning the ability of standard pressure grout equipment to push grout into dry, unconsolidated soils.

It is important to note that a change in either of both of these factors would have resulted in no change to actual quantity of work performed on the project. Had the drilling and backfilling been offered in separate contracts, and some experiments been performed on the unconsolidated soils, it is probable that the overall project cost would have been higher than shown herein.

The overrun in time is only partially attributable to the increase in subsurface quantities. Another important factor was the Contractor's inability to meet the 25 ton/hour minimum production rate for underground stowing. Short comings in this area alone account for over 200 additional working hours beyond the time considered necessary to complete the task. Factors which contributed to this poor record include: (1) failure to deliver a functioning system to the project prior to commencing the work; (2) the Contractor's inexperience with a successful method of high pressure - high volume pneumatic stowing; (3) the inexperience of the supervisor and crew with operating and troubleshooting of the system choosen by the Contractor; (4) the unwillingness of the supervisor to experiment and modify the system in an effort to increase the production rate.

The following steps can be taken to lessen the impact of these factors on future projects:
(1) Require that the Contractor deliver a functioning system to the project with a demonstrable capacity. Projects prior to the Hancock Mine Project required a surface demonstration of the system; however, this was not required on this project because a surface demonstration fails to account for the many factors actually encountered when stowing material is delivered through boreholes to the underground workings, and systems which could be shown to work on the surface failed to function well in subsurface conditions. A good demonstration of a system should include both surface and subsurface presentation.
(2) Previous experience with underground pneumatic stowing has conclusively shown that the moisture content of the backfill material can dramatically affect the stowing production rate. As a rule, the lower the moisture content, the higher the stowing production rate. In addition, underground displacement distance of the stowing material is greatly increased with dry backfill and fewer problems with borehole plugging are encountered. Future projects should require: (A) any backfill material delivered to the site must have a very low moisture content--surface dry as a minimum;

(B) the Contractor must take whatever steps necessary to prevent an increase in the moisture content while the material is stockpiled, in addition to steps taken to further reduce the moisture content prior to incorporation into the stowing system.

Concerning problems encountered with surface work, the application of mulch prior to application of seed and fertilizer will continue to create problems on future projects. The objective is to supply ground cover to disturbed areas during the interval between May and October. The major problem is that conventional grass seed drills are unable to consistantly penetrate the mulch cover, which results in poor depth control for seed and fertilizer, and occasionally an unacceptable disturbance to the ground cover.

Attempts to resolve this problem have included the use of various types of seed drill, including "no till drills". None achieved entirely satisfactory results. While the no till drill demonstrated a somewhat better ability to penetrate, it did not perform well on slopes, or rocky or loose soils. It also presented severe maneuverability limitations which make it impractical for use in small areas or areas with irregular shape.

One solution is to eliminate the intermediate ground cover requirement in areas where other factors either limit the anticipated erosion or no significant erosion is expected. These factors would include the size and shape of the disturbed area; and it's exposure to erosive elements (i.e. slope, soil type, location and orientation). All of these factors are presently available for review prior to finalizing the Plan.

Another solution is to use a temporary artifical ground cover. Biodegradable-water soluable ground stabilizing agents are available.

(3) the Contractor must take whatever steps necessary to prevent an increase in the moisture content while the material is stockpiled, in addition to steps taken to further reduce the moisture content prior to incorporation into the blowing system.

Compounding problems encountered with surface work, the application of mulch prior to application of seed and fertilizer will continue to create problems on future projects. The objective is to supply ground cover to disturbed areas during the interval between May and October. The major problem is that conventional grass seed drills are unable to consistently penetrate the mulch cover, which results in poor depth control for seed and fertilizer, and occasionally an unacceptable disturbance to the ground cover.

Attempts to resolve this problem have included the use of various types of seed drills, including "no till drills". None achieved entirely satisfactory results. While the no till drill demonstrated a somewhat better ability to penetrate, it did not perform well on slopes, or sandy or loose soils. It also presented severe maneuverability limitations which make it impractical for use in small areas or areas with irregular shape.

One solution is to eliminate the intermediate ground cover requirement in areas where other factors either limit the anticipated erosion or no significant erosion is expected. These factors would include the size and shape of the disturbed area, and it's exposure to erosive elements (i.e. slope, soil type, location and orientation). All of these factors are presently available for review prior to finalizing the Plan.

Another solution is to use a temporary artificial ground cover. Biodegradable-water solvable ground stabilizing agents are available.

# APPENDIX A

# Payment Request No. 4 (Final)

RECEIVED
NOV 23 19
LOWELL C. HANSON CO.

From: August 28, 1987 To: October 6, 1987

Project Name: Hancock Mine Project

Location: Sheridan Co. Project No.: MT A/E 86-46-128

Name Of Contractor: Shumaker Trucking Address: PO Box 1442, Great Falls, Mt. 59403

## Summary Of Project Status

| | |
|---|---|
| Amount of Original Contract | $78,654.05 |
| Amount of Approved Change Order(s) | 128,356.00 |
| TOTAL CONTRACT AMOUNT | 207,010.05 |
| Contract Time Used to Date | 108 Days |
| Percentage of Contract Time Used | 83% |
| Percentage of Contract Amount Earned | 100% |

| | |
|---|---|
| Original Contract Amount Completed | $202,854.79 |
| Change Order(s) Amount Completed | 4,155.26 |
| Amount for Materials On Site | 0.00 |
| TOTAL To Date | 207,010.05 |
| Times 90% = No Retainage | |
| TOTAL AMOUNT Earned To Date | 207,010.05 |
| Less Previous Amount Earned | 182,567.39 |
| Amount Payable This Period | 24,442.66 |
| Less 1% Gross Receipts Tax | 244.43 |
| TOTAL DUE CONTRACTOR THIS PERIOD | 24,198.23 |

Requested By: ____________________ (Contractor) Date: 11-11-87

Checked By: L.C. Hanson Co. Allan W. Nye (Engineer) Date: 11/19/87

Approved By: Department of State Lands
Abandoned Mine Reclamation Bureau ____________________ (Owner) Date: 11/19/87

# PAY REQUEST NO. 4 (Final)

L.C Hanson Co.

PROJECT: Hancock Mine Proj. Sched. I MONT A/E 86-46-129 Page 2 Of 7

ITEMIZATION OF QUANTITIES AND COSTS

| ITEM NO. | DESCRIPTION | ESTIMATED PLAN QUANTITY | UNIT BID PRICE | UNITS OF WORK COMPLETED THIS REQUEST | UNITS OF WORK COMPLETED TO DATE | TOTAL COST OF COMPLETED WORK | % OF EST. QUANT. COMP. |
|---|---|---|---|---|---|---|---|
| 1 | Mobilization | 1.0 L.S. | 5000.00 | 0.00 | 1.00 | 5000.00 | 100* |
| 2 | Debris Cleanup | 1.0 L.S. | 200.00 | 0.00 | 1.00 | 200.00 | 100* |
| 3 | Removal of Structures | 1.0 L.S. | 400.00 | 0.00 | 1.00 | 400.00 | 100* |
| 4 | Salvage & Replace Topsoil | 2697.0 C.Y. | 2.00 | 0.00 | 2122.90 | 4245.80 | 100* |
| 5 | Close Mine Openings | | | | | | |
| | a. Adit | 2.0 EACH | 200.00 | 0.00 | 0.00 | 0.00 | 100* |
| 6 | Bank Caving | 1.0 HOUR | 50.00 | 0.00 | 1.00 | 50.00 | 100* |
| 7 | Subsidence Backfill | 77.0 C.Y. | 4.00 | 0.00 | 220.00 | 880.00 | 100* |
| 8 | Subsidence Grading | 1.0 L.S. | 2200.00 | 0.00 | 1.00 | 2200.00 | 100* |
| 9 | Fissure Trench Excavation | | | | | | |
| | and Backfill-6' Deep | 280.0 L.F. | 3.60 | 0.00 | 455.00 | 1638.00 | 100* |
| 10 | Waste Pile Disposal | 1.0 L.S. | 200.00 | 0.00 | 1.00 | 200.00 | 100* |
| 11 | Provide Water | 38.6 MGAL. | 25.00 | 0.00 | 18.00 | 450.00 | 100* |
| 12 | Farm Fence - Type F-3 | 160.0 L.F. | 1.00 | 0.00 | 104.50 | 104.50 | 100* |
| 13 | Single Panel | 2.0 EACH | 65.00 | 0.00 | 2.00 | 130.00 | 100* |
| 14 | Fertilizer | 413.0 LBS. | 0.35 | 374.00 | 374.00 | 130.90 | 100* |
| | Sub-Total | | | | | 15629.20 | |

* Work completed on this item

# PAY REQUEST NO. 4 (Final)

L.C Hanson Co.

PROJECT: Hancock Mine Proj. Sched. I MONT A/E 86-46-123 Page 3 Of 7

ITEMIZATION OF QUANTITIES AND COSTS

| ITEM NO. | DESCRIPTION | ESTIMATED PLAN QUANTITY | UNIT BID PRICE | UNITS OF WORK COMPLETED THIS REQUEST | UNITS OF WORK COMPLETED TO DATE | TOTAL COST OF COMPLETED WORK | % OF EST. QUANT. COMP. |
|---|---|---|---|---|---|---|---|
| 15 | Seed | 94.0 LBS. | 14.50 | 85.60 | 85.60 | 1241.20 | 100* |
| 16 | Mulch | 13380.0 LBS. | 0.30 | 0.00 | 12000.00 | 3600.00 | 100* |
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| | Sub-Total | | | | | 4841.20 | |
| | Total Schedule I | | | | | 20470.40 | |

* Work completed on this item

# PAY REQUEST NO. 4 (Final)

L.C Hanson Co.

PROJECT: Hancock Mine Proj. Sched. II MONT AVE 86-46-128 Page 4 Of 7

## ITEMIZATION OF QUANTITIES AND COSTS

| ITEM NO. | DESCRIPTION | ESTIMATED PLAN QUANTITY | UNIT BID PRICE | UNITS OF WORK COMPLETED THIS REQUEST | UNITS OF WORK COMPLETED TO DATE | TOTAL COST OF COMPLETED WORK | % OF EST. QUANT. COMP. |
|---|---|---|---|---|---|---|---|
| 1 | Traffic Control | 44.0 HOUR | 46.00 | 5.00 | 264.00 | 12144.00 | 100* |
| 2 | Borehole Drilling 4-3/4" | | | | | | |
| | Diameter | 3100.0 L.F. | 2.75 | 694.00 | 11428.50 | 31428.38 | 100* |
| 3 | Borehole Reaming 8" Dia. | 1350.0 L.F. | 3.00 | 0.00 | 5833.00 | 17499.00 | 100* |
| 4 | Casing Pipe - 8" Dia. | 160.0 L.F. | 6.00 | 0.00 | 326.25 | 1957.50 | 100* |
| 5 | Water Injection and | | | | | | |
| | Flooding | 10.0 MGAL. | 25.00 | 0.00 | 45.40 | 1135.00 | 100* |
| 6 | Providing and Stockpiling | | | | | | |
| | Backfill Materials | 1265.0 TONS | 10.00 | 0.00 | 1967.40 | 19674.00 | 100* |
| 7 | Underground Mine Stowing | 1265.0 TONS | 4.90 | -0.65 | 1967.40 | 9640.26 | 100* |
| 8 | Pressure Grout Injection | | | | | | |
| | Setup | 7.0 EACH | 200.00 | 0.00 | 31.00 | 6200.00 | 100* |
| 9 | Pressure Grout Injection | 55.0 C.Y. | 85.00 | 0.00 | 729.25 | 61986.25 | 100* |
| 10 | Gravity Grout Injection | | | | | | |
| | Setup | 12.0 EACH | 175.00 | 0.00 | 0.00 | 0.00 | 100* |
| 11 | Gravity Grout Injection | 160.0 C.Y. | 65.00 | 0.00 | 123.80 | 8047.00 | 100* |
| | | | | | | | |
| | Sub-Total | | | | | 169711.39 | |

* Work completed on this item

# PAY REQUEST NO. 4 (Final)

L.C Hanson Co.

PROJECT: Hancock Mine Proj. Sched. II MONT A/E 86-46-128 Page 5 Of 7

ITEMIZATION OF QUANTITIES AND COSTS

| ITEM NO. | DESCRIPTION | ESTIMATED PLAN QUANTITY | UNIT BID PRICE | UNITS OF WORK COMPLETED THIS REQUEST | UNITS OF WORK COMPLETED TO DATE | TOTAL COST OF COMPLETED WORK | % OF EST. QUANT. COMP. |
|---|---|---|---|---|---|---|---|
| 12 | Backfill Boreholes not | | | | | | |
| | into Void | 24.0 EACH | 65.00 | 10.00 | 138.00 | 8970.00 | 100* |
| 13 | Backfill Boreholes into | | | | | | |
| | Void (Incl. Pipe Stand) | 3.0 EACH | 175.00 | 0.00 | 1.00 | 175.00 | 100* |
| 14 | Road Restoration | 400.0 L.F. | 3.50 | 1008.00 | 1008.00 | 3528.00 | 100* |
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| | Sub-Total | | | | | 12673.00 | |
| | Total Schedule II | | | | | 182384.39 | |

* Work completed on this item

# PAY REQUEST NO. 4 (Final)

L.C Hanson Co.

PROJECT: Hancock Mine Project          MONT A/E 86-46-129          Page 6 Of 7

## ITEMIZATION OF QUANTITIES AND COSTS

| ITEM NO. | DESCRIPTION | ESTIMATED PLAN QUANTITY | UNIT BID PRICE | UNITS OF WORK COMPLETED THIS REQUEST | UNITS OF WORK COMPLETED TO DATE | TOTAL COST OF COMPLETED WORK | % OF EST. QUANT. COMP. |
|---|---|---|---|---|---|---|---|
| | CHANGE ORDER NO.1 (W.O.#1) | | | | | | |
| | 1.Power Line Relocation | | | | | | |
| | a.Sheridan Electric | 1.00 L.S. | 560.00 | 0.00 | 1.00 | 560.00 | 100* |
| | b.Fixed fee | 1.00 L.S. | 121.90 | 0.00 | 1.00 | 121.90 | 100* |
| | 2.Close Mine Opening - | | | | | | |
| | Structural Closure | | | | | | |
| | a.Labor-Concrete Worker | 2.92 HR. | 20.29 | 0.00 | 2.92 | 59.25 | 100* |
| | b.Labor-Iron Worker | 15.00 HR. | 24.06 | 0.00 | 15.00 | 360.90 | 100* |
| | c.Material-Concrete | 14.50 C.Y. | 65.00 | 0.00 | 14.50 | 942.50 | 100* |
| | -Rebar | 1.00 L.S. | 531.39 | 0.00 | 1.00 | 531.39 | 100* |
| | -Visqueen | 432.00 S.F. | 0.05 | 0.00 | 432.00 | 21.60 | 100* |
| | d.Equipment-Winch | 3.08 HR. | 75.00 | 0.00 | 3.08 | 231.00 | 100* |
| | -Vibrator | 0.50 HR. | 20.00 | 0.00 | 0.50 | 10.00 | 100* |
| | e.Excavation & Backfill | 1.00 L.S. | 915.00 | 0.00 | 1.00 | 915.00 | 100* |
| | f.Fixed fee | 1.00 L.S. | 426.80 | 0.00 | 1.00 | 426.80 | 100* |
| | | | | | | | |
| | | | | | | | |
| | Sub-Total | | | | | 4180.34 | |

* Work completed on this item

# PAY REQUEST NO. 4 (Final)

L.C Hanson Co.

| PROJECT: Hancock Mine Project | MONT A/E 86-46-128 | Page 7 Of 7 |
|---|---|---|

## ITEMIZATION OF QUANTITIES AND COSTS

| ITEM NO. | DESCRIPTION | ESTIMATED PLAN QUANTITY | UNIT BID PRICE | UNITS OF WORK COMPLETED THIS REQUEST | UNITS OF WORK COMPLETED TO DATE | TOTAL COST OF COMPLETED WORK | % OF EST. QUANT. COMP. |
|---|---|---|---|---|---|---|---|
| | CHANGE ORDER NO.1 (cont'd.) | | | | | | |
| | 3.Close Add'l. Adit-Equipment | | | | | | |
| | Use Basis | | | | | | |
| | a. D8 Dozer | 1.0 L.S. | 125.00 | 0.00 | 1.00 | 125.00 | 100* |
| | 4.Change Casing Pipe Dia. | | | | | | |
| | from 8" to 6". Reduce Unit | | | | | | |
| | Price by $0.46/L.F. | 326.3 L.F. | -0.46 | 326.25 | 326.25 | -150.08 | 100* |
| | 5.Reconciliation of | | | | | | |
| | Final Quantities | 1.0 L.S. | 123970.74 | 1.00 | 1.00 | 123970.74 | 100* |
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| | Sub-Total | | | | | 123945.66 | |
| | Total | | | | | 128126.00 | |

* Work completed on this item

## 2.12 CHANGE ORDER

Order No. 1

Date: November 9, 1987

Agreement Date: May 11, 1987

NAME OF PROJECT: HANCOCK MINE PROJECT

Sheridan County, MT MT A/E 86-46-128

OWNER: Montana Dept. of State Lands--AMR Bureau

CONTRACTOR: Shumaker Trucking PO Box 1442 Great Falls, MT 59403

Change Orders must be accompanied by an itemized cost breakdown. You are hereby requested to comply with the following changes from the Contract Documents. (Show separate costs for materials, labor, equipment and miscellaneous. Show percent where applicable.)

| ITEM NO. | DESCRIPTION OF CHANGES - ESTIMATED QUANTITIES & UNITS | COST OF CHANGES | | | | | TOTAL COST |
|---|---|---|---|---|---|---|---|
| | | MAT'LS | LABOR | EQUIP. | MISC. | TOTAL UNIT COST | |
| 1. | Reconciliation of Final Quantities<br>(See Attached Sheets) | | | | | | +124,200.74 |
| 2. | Close 3 Mine Openings (Shafts)<br>Structural Closure LUMP SUM<br>Fixed Fee | 1495.49 | 420.15 | 241.00 | 915.00<br>426.80 | | + 3,498.44 |
| 3. | Close 1 Mine Opening (Adit)<br>Equipment Use Basis | | | | | 125.00 | + 125.00 |
| 4. | Change Casing Pipe Diameter from 8" to 6" reduce unit price by $.46/L.F. | | | | | 5.54 | - 150.08 |
| 5. | Temporarily relocate 2 power poles and overhead power line<br>LUMP SUM<br>Fixed Fee | | | | | 560.00<br>121.00 | + 681.00 |

| | |
|---|---|
| TOTAL COST - MAT'LS, LABOR, EQUIPMENT & MISC. | $ 128,356.00 |
| OVERHEAD & PROFIT @ ______ % | Incl. |
| GRAND TOTAL - THIS CHANGE ORDER | $ 128,356.00 |

| | |
|---|---|
| Original Contract Price | $ 78,654.05 |
| Current Contract Price Adjusted by Previous Change Order | 0.00 |
| Cost This Change Order (+ or -) | + $ 128,356.00 |
| New Contract Price Including This Change Order | $ 207,010.05 |

The completion date as set forth in the Contract Documents shall be (~~unchanged~~, increased, ~~decreased~~) by 55 calendar days.

The date for completion of all work will be October 6, 1987.

Description and Justification for Change:

1. The actual quantities shown were necessary to meet field conditions encountered during construction.

2. Two (2) shafts were closed with reinforced concrete slabs and one (1) shaft was closed with a concrete plug to prevent future settlement of the backfill material.

3. Field inspection during construction showed this adit to be less self-reclaimed than originally estimated.

4. Change in casing pipe diameter and reduction in price was made at the Contractor's request.

5. Power line was temporarily relocated to facilitate backfilling of mine voids underlying the overhead power line location.

---

## SURETY CONSENT

The surety hereby consents to the aforementioned Contract Change Order and agrees that its bond or bonds shall apply and extend to the Contract as thereby modified or amended per this Change Order. The principal and the Surety further agree that on or after execution of this consent, the penalty of the applicable Performance Bond or Bonds is hereby increased by ONE HUNDRED TWENTY EIGHT THOUSAND THREE HUNDRED FIFTY SIX-- ($ 128,356.00-------) (One hundred percent (100%) of the Change Order amount) and the penalty of the applicable Payment Bond or Bonds is hereby increased by ONE HUNDRED TWENTY EIGHT THOUSAND THREE HUNDRED FIFTY SIX---------($ 128,356.00-------------) (One hundred percent (100%) of the Change Order amount).

| COUNTERSIGNED BY MONTANA RESIDENT AGENT | SURETY |
|---|---|
| COGSWELL AGENCY | FIREMAN'S FUND INSURANCE COMPANY |
| BY: Sandra Kay Kirk | BY: Sandra K. Kirk |
| RESIDENT AGENT | SANDRA K. KIRK (Seal) |

---

Recommended by: L. C. Hanson Company Allan W. Tye, Engineer Date 11/9/87

Accepted by: ______________________, Contractor 11/11/87

Approved by: ______________________, Owner 11/17/87

Change Order No. 1
HANCOCK MINE PROJECT

## RECONCILIATION OF FINAL QUANTITIES

### SCHEDULE I - SURFACE WORK

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | ACTUAL QUANTITY | CHANGE IN PRICE |
|---|---|---|---|---|
| 4. | SALVAGE & REPLACE TOPSOIL | 2697.0 C.Y. | 2122.9 C.Y. | -$ 1,148.20 |
| 5. | CLOSE MINE OPENING | 2.0 EACH | 0.0 EACH | - 400.00 |
| 7. | SUBSIDENCE BACKFILL | 77.0 C.Y. | 220.0 C.Y. | + 572.00 |
| 9. | FISSURE TRENCH EXCAVATION | 280.0 L.F. | 455.0 L.F. | + 630.00 |
| 11. | PROVIDE WATER | 38.6 MGAL | 18.0 MGAL | - 515.00 |
| 12. | FARM FENCE - TYPE F-3 | 160.0 L.F. | 104.5 L.F. | - 55.50 |
| 14. | FERTILIZER | 413.0 LBS. | 374.0 LBS. | - 13.65 |
| 15. | SEED | 94.0 LBS. | 85.6 LBS. | - 121.80 |
| 16. | MULCH | 13,380.0 LBS. | 12,000.0 LBS. | - 414.00 |
| | | Sub-Total - SCHEDULE I | | -$ 1,466.15 |

### SCHEDULE II - SUBSURFACE WORK

| | | | | |
|---|---|---|---|---|
| 1. | TRAFFIC CONTROL | 44.0 HOURS | *264.0 HOURS | +$ 10,120.00 |
| 2. | BOREHOLE DRILLING 4-3/4" DIAMETER | 3,100.0 L.F. | 11,428.5 L.F. | + 22,903.38 |
| 3. | BOREHOLE REAMING 8" DIA. | 1,350.0 L.F. | 5,833.0 L.F. | + 13,449.00 |
| 4. | CASING PIPE 8" DIAMETER | 160.0 L.F. | 326.25 L.F. | + 997.50 |
| 5. | WATER INJECTION & FLOODING | 10.0 MGAL | 45.4 MGAL | + 885.00 |
| 6. | PROV. AND STOCKPILE BACKFILL MATERIALS | 1,265.0 TONS | 1,967.4 TONS | + 7,024.00 |
| 7. | UNDERGROUND MINE STOWING | 1,265.0 TONS | 1,967.4 TONS | + 3,441.76 |
| 8. | PRESS. GROUT INJ. SETUP | 7.0 EACH | 31.0 EACH | + 4,800.00 |
| 9. | PRESS. GROUT INJ. | 55.0 C.Y. | 729.25 C.Y. | + 57,311.25 |
| 10. | GRAV. GROUT INJ. SETUP | 12.0 EACH | 0.0 EACH | - 2,100.00 |
| 11. | GRAV. GROUT INJ. | 160.0 C.Y. | 123.8 C.Y. | - 2,353.00 |
| 12. | BKFL. BOREHOLE NOT INTO VOID | 24.0 EACH | 138.0 EACH | + 7,410.00 |
| 13. | BKFL. BOREHOLE INTO VOID (INCL. PIPE STAND) | 3.0 EACH | 1.0 EACH | - 350.00 |

*5.0 additional hours claimed by Contractor and approved by Owner (DSL)

## RECONCILIATION OF FINAL QUANTITIES

### SCHEDULE II - SUBSURFACE WORK (CONT'D)

| ITEM NO. | DESCRIPTION | ESTIMATED QUANTITY | ACTUAL QUANTITY | CHANGE IN PRICE |
|---|---|---|---|---|
| 14. | ROAD RESTORATION | 400.0 L.F. | 1008.0 L.F. | +$ 2,128.00 |
| | | Sub-Total - SCHEDULE II | | +$ 125,666.89 |
| | | TOTAL CHANGE IN PRICE | | +$ 124,200.74 |

# APPENDIX B

## HANCOCK MINE PROJECT

## SLIDE AND PHOTO LOG

| PHOTO NO. | DESCRIPTION |
|---|---|
| NOTE: | The following seven photographs are all aerial obiques of the site,taken prior to any work at the site. |
| 1. | Aerial oblique of entire project site; looking east. Areas #1, 2, 3, and 5 are surface work areas, Area #4 encompasses county road from arrow tip west to house and comprises the subsurface work. |
| 2. | Aerial oblique of a portion of Area #1. Area #1 located north of barn shown. |
| 3. | Aerial oblique of Area #3 and a portion of Area #4. Area #3 encompassed an area from the county road north and east of the foundation shown. |
| 4. | Aerial oblique of Areas #2, 3, 4, &6. Also a portion of Area #1 is visible to far right, atop the bench. The small dark patch between the field and the crest of the bench is the air shaft in Area #1. The lines, that appear to be trails running from the field to the crest of the bench are actually fissures of Areas #1 and 2. |
| 5. | Aerial oblique of Areas #2 & 3. This photo offers a closer view of Area #2 than does photo No. 4. Fissures visible atop bench and subsidence features on face of slope. Channel bottom is at bottom of photo. Approximately 100 vertical feet from channel to bench top; predominately at a 2:1 slope. |
| 6 & 7. | Aerial oblique of Area #5. Area #5 North, encompassed the subsidence features along and south of the channel bottom. Area #5 South, located atop the bench between the county road and bench crest. Faint signs of mine access from county road leads to Area #5 hoist shaft and accompaning waste pile. |

| SLIDE NO. | DESCRIPTION |
|---|---|
| A1-A2 | Salvaging topsoil in Area #3, in preparation for stockpiling stowing backfill material. |
| A3-A4 | Exploratory borehole drilling along county road in Area #4 east. |
| A5 | Water flooding of active subsidence hole along county road. |
| A6-A12 | Sequence shows stowing operation setup and equipment. Foot piece shown in A9 & A10 was connected to 2" air feed line and lowered to void inside a 6" PVC casing (see A12) used as solids conduit. A10 shows hopper positioned next to borehole. Hopper is feed from backfill stockpile with 3 cyd. frontend loader. |
| A13 | Shows all subsurface operation at work; looking east along road. From closest to furthest, flagperson, borehole drilling, stowing, and grouting. |
| A14 | Grouting operation at work. Flexible line runs from pump to 70 vertical feet of 3" steel pipe, which has been placed in borehole to void. 8 cyd. mixer truck delivers grout from off-site plant. |
| A15 | Borehole drilling on road surface. |
| A16-A20 | Shows monitor view of underground camera system. A16 & A17 shows an open, intact, dry mine room. Rooms were typically 6 ft. high and from 12 to 16 ft. in width. Light has been suspended in borehole approximately 30 ft. forward of camera location. A18-A20 shows stowing foot piece descending into mine room. Pile beneath foot piece is cuttings pile from drilling. |
| B1 | Frontend loader salvaging topsoil in Area #1. |
| B2-B8 | Sequence shows Area #2 surface work in progress. Topsoil stockpiled at top of bench and along right side of work area. Borrow for regrade comes from area close to bench top. |
| B9-B11 | Shows Area #5 (north portion) surface work in progress. |

| | |
|---|---|
| B12-B15 | Shows waste pile disposal in Area #5. Disposal pit was excavated to west of shaft, after topsoil salvage in area. Also shows backhoe excavating hoist shaft. |
| B16 | Shows shaft excavation in Area #1. |
| B17-B20 | Shows construction of reinforced concrete slab for structural shaft closure. |
| C1-C5 | Shows revegetation work. Steeper slopes were mulched and seeded by hand and tracked with dozer. All other areas were completed with mechanical equipment. |
| C6-C9 | Shows restoration of county road surface after all subsurface work was completed. |

# APPENDIX C

# HANCOCK MINE RECLAMATION PROJECT

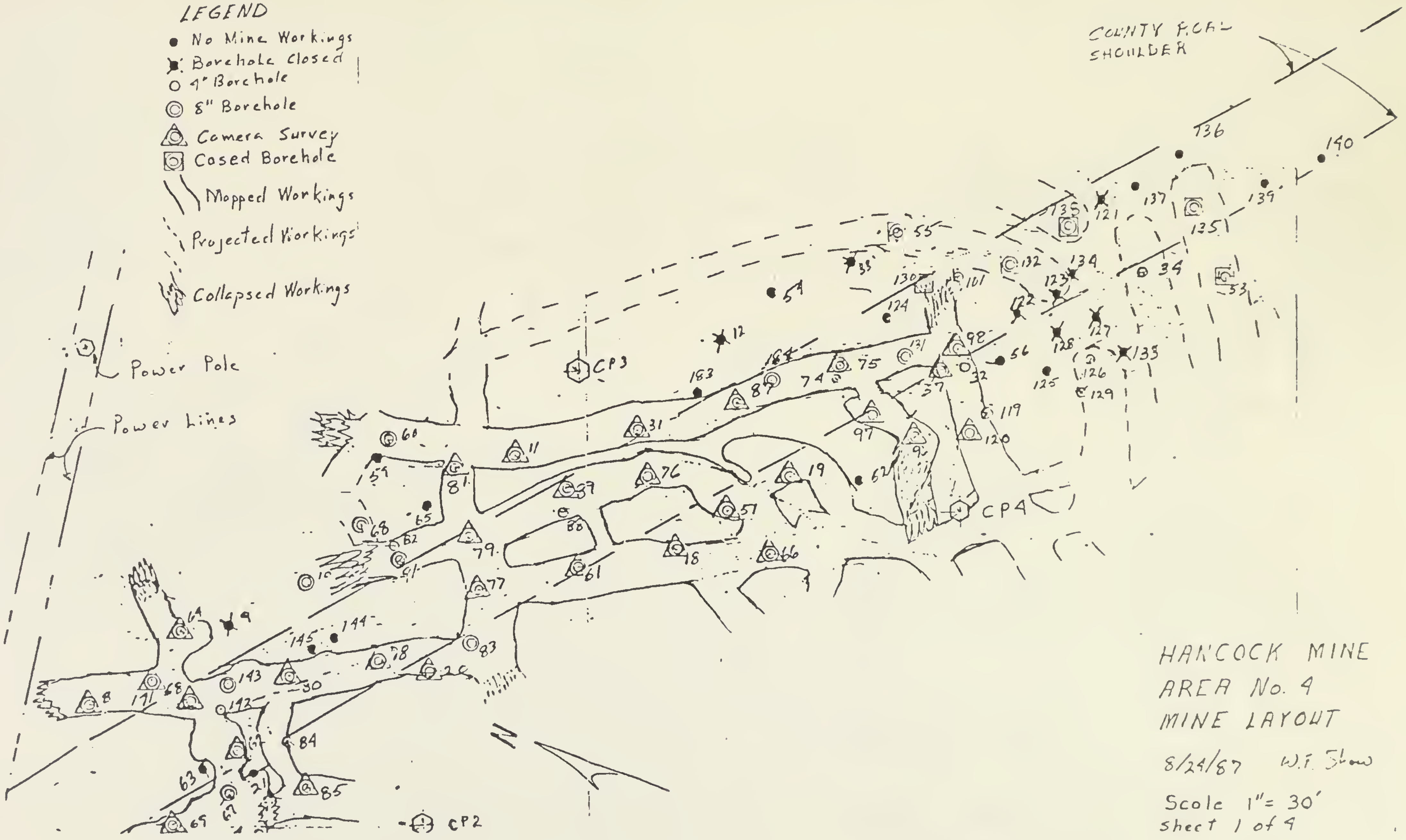
## SUBSURFACE FINDINGS

## I. MINE LAYOUT:

The mapping of the borehole drilling for the Hancock Mine Project is presented in four sheets (1 of 4 thru 4 of 4). The mapping is shown in consecutive order beginning at the east end of project. These sheets are copies of the mapping assembled during the project, which have been reduced in scale.

**LEGEND:**

| TERM | DEFINITION |
|---|---|
| NO MINE WORKINGS | Indicates boreholes which did not encounter mine working. |
| BOREHOLE CLOSED<br>or<br>BOREHOLE BACKFILLED | Indicates boreholes which had been backfilled prior to the start of construction project. |
| 4" BOREHOLE | Indicates exploratory boreholes used to find the working and establish the underground conditions. |
| 8" BOREHOLE | Indicates production boreholes used to backfill the workings or permit underground surveys. |
| CAMERA SURVEY | Indicates boreholes where underground surveying occured. |
| CASED BOREHOLE | Indicates boreholes where a 6 in. PVC casing was installed to prevent premature collapse of the borehole. |
| MAPPED WORKINGS | Indicates the mine room layout that was accomplished using the underground camera. |
| PROJECTED WORKINGS | Indicates projected mine room layout. Usually these are areas where the workings were collapsed and prevented the use of the underground survey system. |
| COLLAPSED WORKINGS | Indicates area where collapse was verified with the underground camera. |

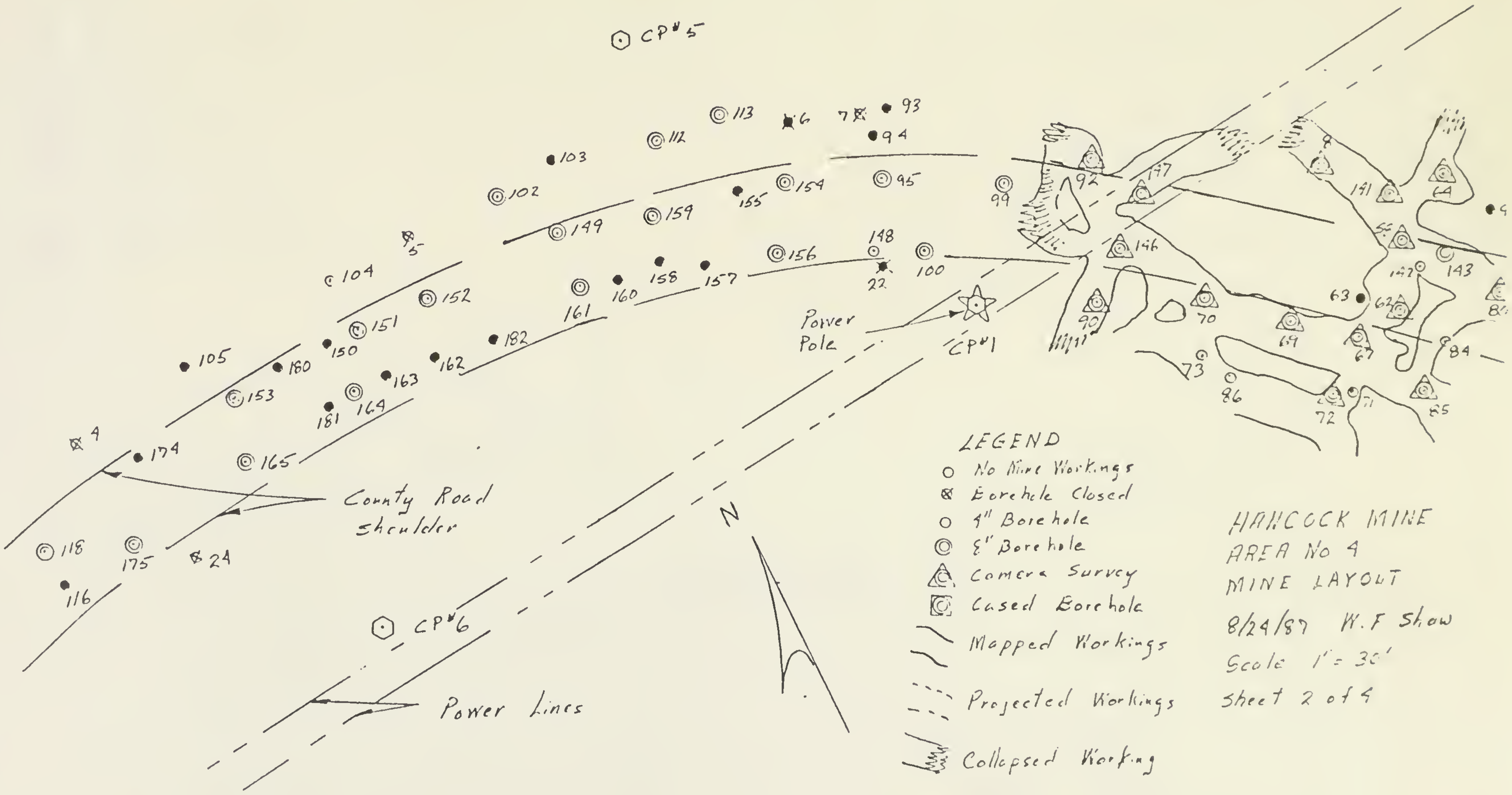


HANCOCK MINE
AREA No. 4
MINE LAYOUT

8/24/87 W.T. Shaw

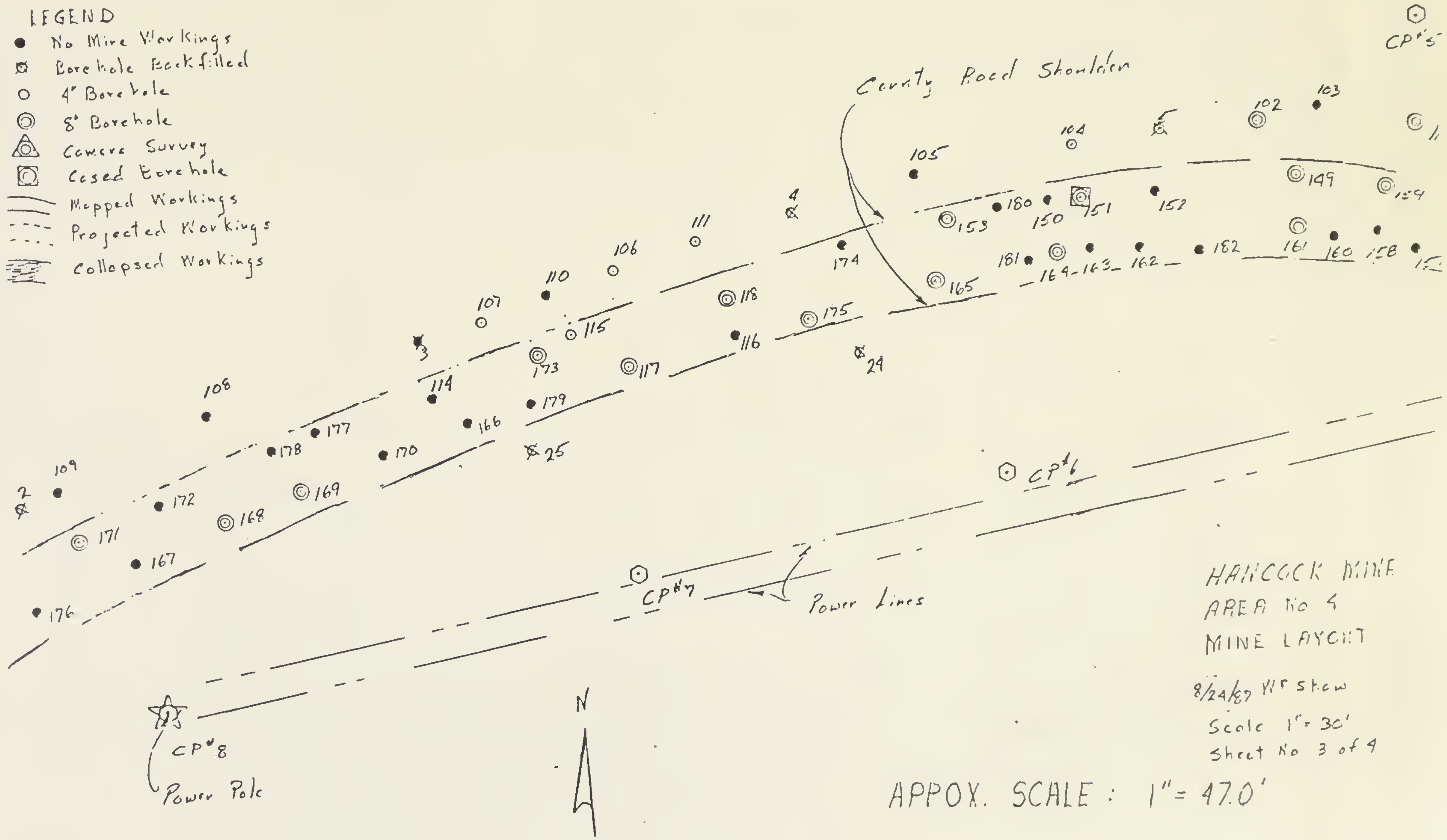
Scale 1" = 30'
sheet 1 of 4

APPROX. SCALE: 1" = 470'



HANCOCK MINE
AREA No 4
MINE LAYOUT
8/24/87 W. F Show
Scale 1" = 30'
Sheet 2 of 4

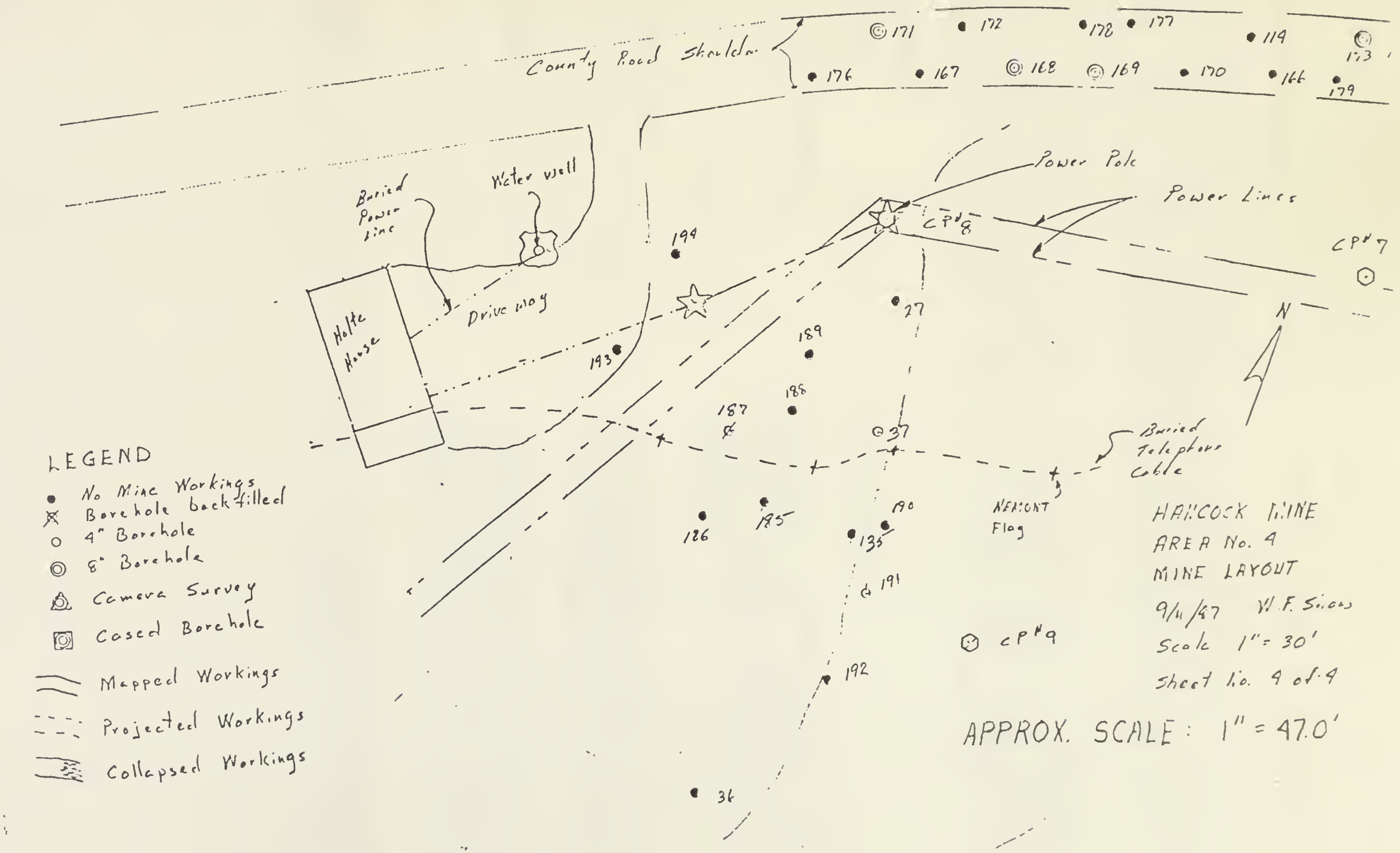
APPROX SCALE : 1" = 47.0'



HANCOCK MINE
AREA No 4
MINE LAYOUT

8/24/87 WF Shew
Scale 1" = 30'
Sheet No 3 of 4

APPOX. SCALE : 1" = 47.0'


County Road Shoulder
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168
169
170
166
179
Power Pole
Power Lines
CP#8
CP#7
N
Water well
Buried Power Line
Drive way
Holte House
194
193
27
189
188
187
37
Buried Telephone Cable
NEMONT Flag
185
126
190
135
191
192
36
CP#9
LEGEND
● No Mine Workings
☒ Borehole backfilled
○ 4" Borehole
◎ 8" Borehole
Camera Survey
Cased Borehole
Mapped Workings
Projected Workings
Collapsed Workings
HANCOCK MINE
AREA No. 4
MINE LAYOUT
9/11/87 W.F. Simons
Scale 1" = 30'
Sheet No. 4 of 4
APPROX. SCALE: 1" = 47.0'

## II. SOILS PROFILE

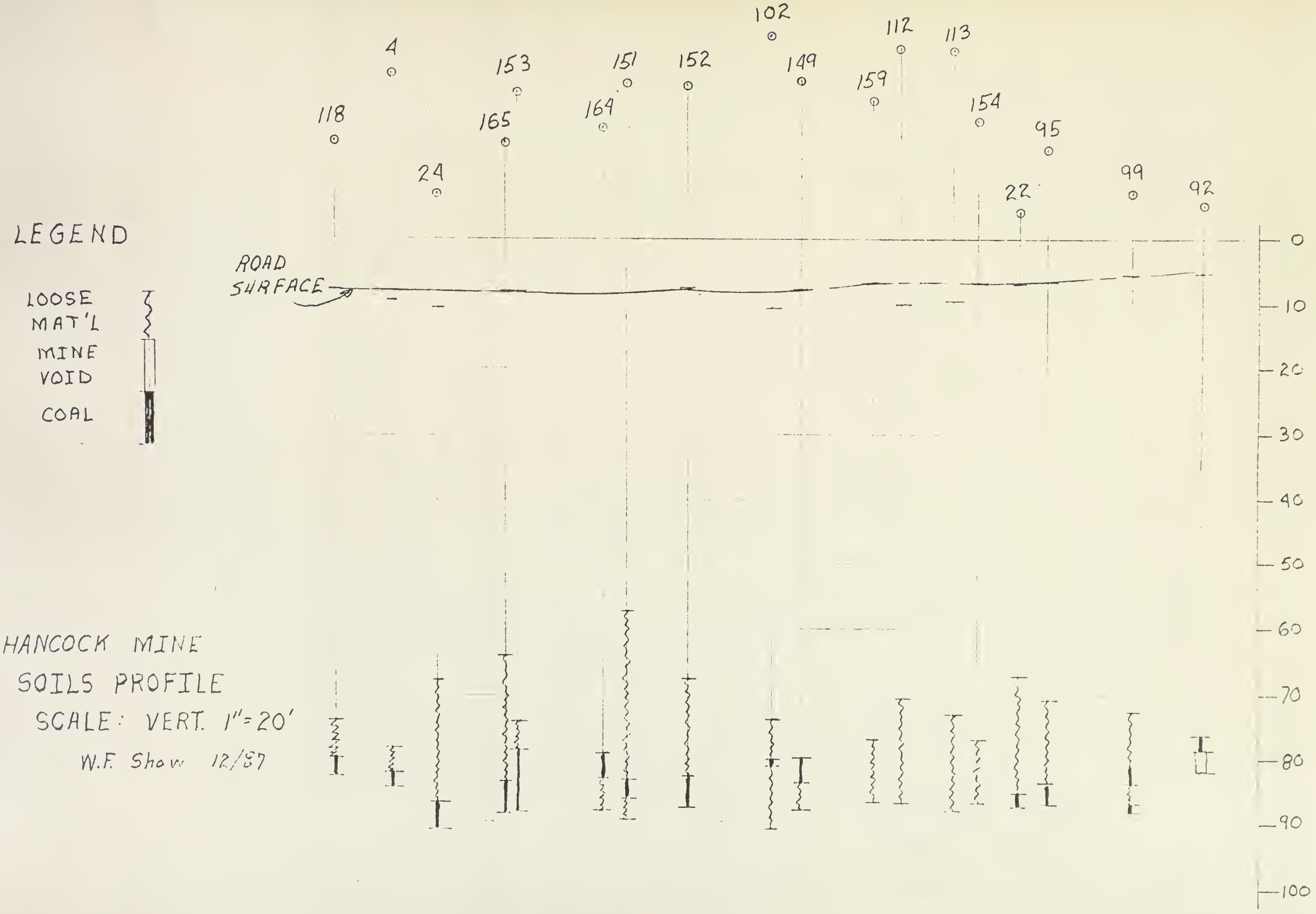
Profiles are presented for the western portion of the project. These boreholes are shown in profile in addition to the surface location because no projection of the mine layout was made. The **horizontal** scale for the profile matches the **approximate scale** shown on the MINE LAYOUT mapping.

The majority of these workings were collapsed; thus preventing an underground survey of the area. Borehole #92, on sheet 1 of 2, is the only surveyed room shown and is part of the mine workings which lie to the east. Note the abrupt change in the height of the coal seam in this area.

**LEGEND:**

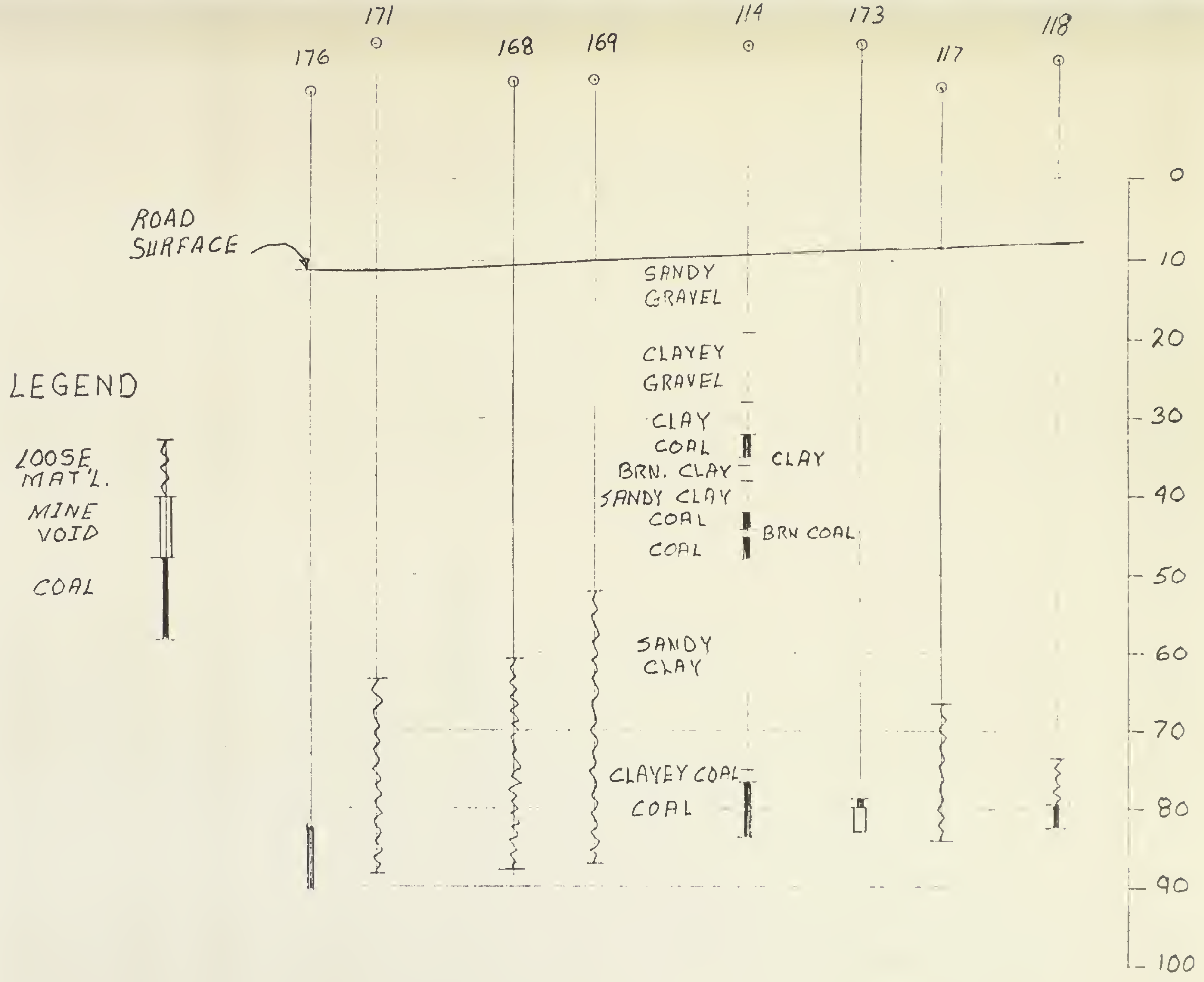
| TERM | DEFINITION |
|---|---|
| LOOSE MATERIAL | Indicates zones where the mine ceiling has collapsed and has either begun to migrate to the surface or fill adjacent rooms with material. |
| MINE VOID | Indicate mine rooms which are a least partially intact or zones in the collapse migration route which are not filled with loose material. |
| COAL | Indicates the coal seam. Portions of the seam may have been removed during mining or may represent the ceiling which has collapsed to the floor. |

**NOTE:** A full length identified soils profile is shown on sheet 2 of 2 at borehole #114. This profile well represents the soils conditions encountered throughout the project.



HANCOCK MINE
SOILS PROFILE
SCALE: VERT. 1"=20'
W.F. Show 12/87

SHEET 1 OF 2



HANCOCK MINE
SOILS PROFILE
SCALE: VERT. 1" = 20'
W.F. Show 12/87

SHEET 2 OF 2

# APPENDIX D

ANALYSIS OF PROFESSIONAL SERVICE FEES
DATE OF PREPARATION: December 22, 1987
PROJECT: Hancock Mine

| PROFESSIONAL SERVICE | AMOUNT |
|---|---|
| * Data Gathering, Site Evaluation, Preliminary Engineering, Final Engineering, Bidding Documents | $43,247.44 |
| * Construction Administration, Construction Inspection, Final Report Preparation | $27,129.63 |
| L.C. HANSON CO. COSTS | $70,377.07 |
| CONSTRUCTION COSTS | $207,010.05 |

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PERCENTAGE ANALYSIS

| | |
|---|---|
| PRE-CONST. LCH CO COST/CONSTRUCTION COST | 20.89% |
| CONST. & POST CONST. LCH CO. COST/CONSTRUCTION COST | 13.11% |
| TOTAL LCH CO. COST/CONSTRUCTION COST | 34.00% |

***

REMARKS: Services provided include lien determination, landowner consent, budget preparation, grant application, weed board approval, basic engineering, construction staking, contract administration, quantity accounting and full time resident inspection. This project involved extensive remote television survey of the mine workings and television monitoring of the remote backfill and grouting process for subsidence control. The construction period was very lengthy due to very slow progress by the contractor. The pre-construction phase included extensive site investigation work involving exploratory drilling and remote television survey.

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